CLAIMS

We claim:

1. In a human-computer interface, a method of allowing a user of a haptic input device to affect the motion of an object in a computer application, comprising:
   a) Establishing an object fundamental path representing a path of motion of the object in the computer application;
   b) Establishing a device fundamental path in correspondence with the object fundamental path;
   c) Detecting motion of the input device;
   d) Moving the object in the computer application along the object fundamental path responsive to a component of input device motion along the device fundamental path; and
   e) Applying a force to the input device responsive to a component of input device motion not along the device fundamental path.
2. A method as in Claim 1, wherein the force resists motion of the input device not along the device fundamental path.
3. A method as in Claim 1, further comprising applying a force to the input device responsive to interaction of the object with the application.
4. A method as in Claim 1, further comprising applying forces to the input device corresponding to motion of the object in the application, wherein the forces provide a perception of momentum and inertia of the input device corresponding to momentum and inertia of the object in the application.
5. A method as in Claim 1, wherein the application comprises a plurality of states, and wherein the object fundamental path is dependent on the state of the application.
6. A method as in Claim 1, wherein the application comprises a plurality of states, and wherein the device fundamental path is dependent on the state of the application.
7. A method as in Claim 1, wherein the object interacts with the application, and wherein the interaction of the object with the application is dependent on the speed of the object along the object fundamental path.
8. A method as in Claim 1, further displaying a visual representation of the object to the user.

9. A method as in Claim 8, wherein the visual representation when the device is on the device fundamental path is perceptively different from the visual representation when the device is not on the device fundamental path.

10. A method as in Claim 1, further comprising:

a) Establishing a second object fundamental path representing a path of motion of a second object in the computer application;

b) Establishing a second device fundamental path in correspondence with the second object fundamental path;

c) Detecting motion of the input device;

d) Determining if either device fundamental path is active, and if so, then

e) Moving the object in the computer application along the active object fundamental path responsive to a component of input device motion along the active device fundamental path; and

f) Applying a force to the input device responsive to a component of input device motion not along the active device fundamental path.

11. A method as in Claim 1, wherein the object comprises two representations, a visual representation that is used in a display to provide visual feedback to the user, and an interaction representation that is used with the input device to provide force feedback to the user.

12. A method as in Claim 2, wherein the force has a first magnitude for a first position of the input device a first distance from the device fundamental path, and a second, larger magnitude for a second position of the input device a second, larger distance from the device fundamental path.

13. A method as in Claim 1, further comprising applying a force along the device fundamental path opposing motion of the input device beyond an end of the device fundamental path.

14. A method as in Claim 1, further comprising applying a force to the input device to urge the input device to a starting region of the range of motion of the haptic input device.

15. A method as in Claim 1, wherein the device fundamental path has a different shape than the object fundamental path.

16. A method as in Claim 1, wherein the device fundamental path defines a curve in three-dimensions.

17. A method as in Claim 16, wherein the device fundamental path defines a curve in two-dimensions.

18. A method as in Claim 1, wherein the device fundamental path defines a surface in three-dimensions.

19. A method as in Claim 1, wherein a characteristic of the object in the application is responsive to motion of the input device off the device fundamental path.

20. A method as in Claim 1, wherein the force resists motion of the input device off the device fundamental path along a first dimension, and wherein a characteristic of the object in the application is responsive to motion of the input device off the device fundamental path along a second dimension different from the first dimension.

21. A method as in Claim 1, wherein the magnitude of the force is partially dependent on the position of the object along the object fundamental path.

22. A method as in Claim 1, wherein the magnitude of the force is partially dependent on interaction of the object with the application.

23. A method as in Claim 1, wherein the magnitude of the force is partially dependent on a user-assistance parameter of the interface.

24. A method as in Claim 23, wherein the user-assistance parameter is established by a measure of the user's proficiency in manipulating the input device.

25. A method as in Claim 1, additionally comprising:
    a) Defining a motion-initiation region comprising a portion of the input device range of motion;
    b) Determining when the input device is within the motion-initiation region; and
    c) When the input device is within the motion-initiation region, applying a force to the input device urging the input device to the device fundamental path.

26. A method as in Claim 1, wherein establishing a device fundamental path comprises:
    a) Determining when the user supplies a motion-initiation signal; and then
    b) Establishing a device fundamental path according to a defined device path and the position of a cursor controlled by the user when the motion-initiation signal was supplied.

27. A method as in Claim 26, wherein the motion-initiation signal comprises motion of the cursor to a defined range of the cursor's range of motion.

28. A method as in Claim 26, wherein the motion-initiation signal comprises a switch actuated by the user.

29. A method as in Claim 27, wherein the motion-initiation signal further comprises detection of the position of the cursor in a defined range of the cursor's range of motion when the switch is actuated.

30. A method as in Claim 26, wherein the motion-initiation signal comprises motion of the input device having defined characteristics.

31. A method as in Claim 1, wherein:

a) The computer application comprises a golf simulation;

b) The object comprises a golf club; and

c) The object fundamental path comprises a path suited for perception of the swing of a golf club.

32. A method as in Claim 1, wherein:

a) The computer application comprises a pool simulation;

b) The object comprises a pool cue; and

c) The object fundamental path comprises a path suited for perception of the motion of a pool cue.

33. A human-computer interface, comprising:

a) A haptic input device;

b) A means for detecting motion of the input device;

c) A means for displaying an object whose position along an object fundamental path is responsive to motion of the input device along a device fundamental path;

d) A means for applying a force to the input device responsive to motion of the input device.